CLAIMS

1. A multilayer structure, comprising:

a silicon based substrate; and

an epitaxial $Cd_{1-z}Zn_zX_xX'_{1-x}$ film grown on the silicon based substrate, where X is a chalcogenide selected from the group consisting of S and Se; X′ is a higher atomic number chalcogenide relative to X and X′ is selected from the group consisting of S, Se and Te; x is a number greater than zero and less than 1; and z is a number greater than or equal to zero and less than one.

2. The structure of claim 1 wherein X is Se and X′ is Te.

3. The structure of claim 2 wherein z is zero.

4. The multilayer structure of claim 1, wherein the silicon based substrate has a CdX′ overlayer in contact with the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film.

5. The multilayer structure of claim 1, wherein the silicon based substrate is a single crystal.

6. The multilayer structure of claim 1, wherein x+z is less than 0.10.

7. The multilayer structure of claim 1, wherein x+z is between 0.01 and 0.08.

8. The multilayer structure of claim 1, wherein x+z is between 0.03 and 0.05.

9. The multilayer structure of claim 3, wherein x is between 0.01 and 0.08.

10. The multilayer structure of claim 3, wherein x is between 0.03 and 0.05.

11. The multilayer structure of claim 1, wherein the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film has a surface defect density equal to or less than 2000 per centimeter squared.

12. The multilayer structure of claim 11, wherein the surface defect density is less than 500 per square centimeter.

13. The multilayer structure of claim 1, further comprising a $Hg_{1-y}Cd_yTe$ layer grown on the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film, the $Hg_{1-y}Cd_yTe$ layer being substantially lattice matched to the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film.

14. The multilayer structure of claim 13, wherein X is Se and X′ is Te.

15. The multilayer structure of claim 14, wherein x+z is between 0.01 and 0.08 and y is between 0.15 and 0.35.

16. The multilayer structure of claim 13, wherein z is zero.

17. The multilayer structure of claim 16, wherein X is Se and X′ is Te.

18. The multilayer structure of claim 16, wherein x is between 0.01 and 0.08 and y is between 0.15 and 0.35.

19. The multilayer structure of claim 1, further comprising a cadmium chalcogenide layer grown on the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film.

20. The multilayer structure of claim 14 wherein the cadmium chalcogenide layer and the $Cd_{1-z}Zn_zX_xX'_{1-x}$ film are substantially lattice matched.

21. A $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film grown by molecular beam epitaxy on a silicon based substrate, where x is a number between zero and one inclusive and z is greater than zero and less than one.

22. The $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film of claim 21 wherein x+z is less than 0.10.

23. The $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film of claim 21, wherein the $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film has a surface defect density of less than 2000 per square centimeter.

24. The $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film of claim 21, having an overlayer of $Hg_{1-y}Cd_yTe$ thereon.

25. The $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film of claim 24, wherein the $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film is substantially lattice matched to the overlayer of $Hg_{1-y}Cd_yTe$.

26. The film of claim 24, wherein x+z is between 0.01 and 0.08 and y is between 0.15 and 0.35.

27. The film of claim 21 wherein the $Cd_{1-z}Zn_zSe_xTe_{1-x}$ film is grown from a $Cd_{1-z}Zn_zTe$ source and a Se source (not quite clear here?).

28. A $CdSe_xTe_{1-x}$ film grown by molecular beam epitaxy on a silicon based substrate, where x is a number between 0 and 1 inclusive and z is greater than zero and less than one.

29. The $CdSe_xTe_{1-x}$ film of claim 28 wherein x is less than 0.10.

30. The $CdSe_xTe_{1-x}$ film of claim 28, wherein the $CdSe_xTe_{1-x}$ film has a surface defect density of less than 2000 per square centimeter.

31. The $CdSe_xTe_{1-x}$ film of claim 28, having an overlayer of $Hg_{1-y}Cd_yTe$ thereon.

32. The $CdSe_xTe_{1-x}$ film of claim 31, wherein the $CdSe_xTe_{1-x}$ film is substantially lattice matched to the overlayer of $Hg_{1-y}Cd_yTe$.

33. The film of claim 31, wherein x is between 0.01 and 0.08 and y is between 0.15 and 0.35.

34. The film of claim 28 wherein the $CdSe_xTe_{1-x}$ film is grown from a CdTe source and a Se source.

35. A method of growing an epitaxial film of $Cd_{1-z}Zn_zX_xX'_{1-x}$, comprising the steps of:

providing a substrate;

growing a crystalline layer of CdX′ on the substrate by molecular beam epitaxy; and

growing the epitaxial film of $Cd_{1-z}Zn_zX_xX'_{1-x}$ on the layer of CdX′ by molecular beam epitaxy where X and X′ are different chalcogenides and each is selected from the group S, Se and Te and X has lower atomic number than X′, x is a number greater than zero and less than one, and z is a number greater than or equal to zero and less than one, where the epitaxial film of $Cd_{1-z}Zn_zX_xX'_{1-x}$ is grown from multiple sources selected from the group consisting of: $Cd_{1-z}Zn_zX'$, X; Cd, Zn, X′, X; $Cd_{1-z}Zn_zX'$, Zn, Cd, X; CdX′, Zn, X; and $Cd_{1-z}Zn_zX'$, Cd, X.

36. The method of claim 35, where X is Se and X′ is Te.

37. The method of claim 36 where the multiple sources are CdTe, ZnTe, CdSe, Cd, Te, Se sources.

38. The method of claim 35 further comprising the step of: annealing the layer of CdX′ prior to growing the epitaxial film.

39. The method of claim 35, wherein the epitaxial film of $Cd_{1-z}Zn_zX_xX'_{1-x}$ is grown using an X flux from the X source and a $Cd_{1-z}Zn_zX'$ flux from the ZnX' and CdX' compound sources., there being a flux ratio of ZnX'+X fluxes to CdX' flux, the flux ratio being less than approximately 0.08.

40. The method of claim 39, wherein the flux ratio is between 0.02 and 0.06, and preferably 0.04.

41. The method of claim 35 wherein the substrate is selected from the group consisting of: a silicon, gallium arsenide and indium antimonide.

42. The method of claim 35, wherein the epitaxial film of $Cd_{1-z}Zn_zX_xX'_{1-x}$ is grown at a film growth temperature, the film growth temperature being between 300°C and 450°C.

43. The method of claim 42 where X is Se and X′ is Te.

44. The method of claim 42 wherein the film growth temperature is between approximately 340°C and approximately 380°C.

45. The method of claim 35 further comprising the step of annealing during the growth of the layer of $Cd_{1-z}Zn_zX_xX'_{1-x}$.

46. A method of growing an epitaxial film of $CdX_xX'_{1-x}$, comprising the steps of:

providing a substrate;

growing a crystalline layer of CdX′ on the substrate by molecular beam epitaxy; and

growing the epitaxial film of $CdX_xX'_{1-x}$ on the layer of CdX′ by molecular beam epitaxy where X and X′ are different chalcogenides and each is selected from the group

S, Se and Te and X has lower atomic number than X′, x is a number greater than zero and less than one, from multiple sources selected from the group consisting of: CdX′, X; Cd, X′, X; and CdX′, Cd, X.

47. The method of claim 46, where X is Se and X′ is Te.

48. The method of claim 47 where the multiple sources are CdTe and Se sources.

49. The method of claim 46, wherein the epitaxial film of $CdX_xX'_{1-x}$ is grown using an X flux from the X source and a CdX′ flux from the CdX′ compound source, there being a flux ratio of X flux to CdX′ flux, the flux ratio being less than approximately 0.08.

50. The method of claim 49, wherein the flux ratio is between 0.02 and 0.04.

51. The method of claim 46 wherein the substrate is selected from the group consisting of: a silicon, gallium arsenide and indium antimonide.

52. The method of claim 46, wherein the epitaxial film of $CdX_xX'_{1-x}$ is grown at a film growth temperature, the film growth temperature being between 300°C and 450°C.

53. The method of claim 52 where X is Se and X′ is Te.

54. The method of claim 52 wherein the film growth temperature is between approximately 340°C and approximately 380°C.

55. The method of claim 46 further comprising the step of annealing during the growth of the layer of $CdX_xX'_{1-x}$.

56. A radiation detector, comprising:

a silicon based substrate;

a film of $Cd_{1-z}Zn_zX_xX'_{1-x}$ grown on the silicon based substrate; and

a radiation sensing layer grown on the film of $CdX_xX'_{1-x}$, where X is a chalcogenide selected from the group consisting of: S and Se; X′ is a higher atomic number chalcogenide relative to X and X′ is selected from the group consisting of S, Se,

and Te; and x is a number greater than zero and less than one, and z is a number greater than or equal to zero and less than one.

57. The radiation detector of claim 56 where X is Se and X′ is Te.

58. The radiation detector of claim 56 wherein z is zero.

59. The radiation detector of claim 56 where x+z is less than 0.10.

60. The radiation detector of claim 56, wherein the radiation sensing layer is a layer of $Hg_{1-y}Cd_yTe$.

61. The radiation detector of claim 56, wherein the radiation sensing layer is a layer of CdX′.

62. The radiation detector of claim 60 where X is Se and X′ is Te and z is zero.

63. The radiation detector of claim 57 wherein the radiation sensing layer is substantially lattice matched to film of $Cd_{1-z}Zn_zSe_xTe_{1-x}$.

64. The radiation detector of claim 58 wherein the radiation sensing layer is substantially lattice matched to film of $Cd_{1-z}Zn_zSe_xTe_{1-x}$.

65. The radiation detector of claim 62 wherein x is between 0.01 and 0.08.

66. The radiation detector of claim 60 wherein x is Se, X′ is Te, and x+z is between 0.01 and 0.08.

67. The radiation detector of claim 62, wherein y is between 0.15 and 0.35.

68. The radiation detector of claim 66, wherein y is between 0.15 and 0.35.